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(54) Improvements to gas selector valves

(57) In gas analysis systems it is frequently necessary to draw a gas sample from one of an array of pipes each of which conveys gas from a different remote position to the central monitoring point. In order that the gas sample may be fresh the pipes not in use must be continuously purged while the gas sample is being withdrawn and analysed from the selected pipe.

The valve in this invention consists of a stator 1 to which the sampling pipes 2 are brought and arranged in a circular ring. The outlets are coupled to a rotor 5 so shaped and positioned that only one pipe is connected through to the analyser whilst all the others are connected to the vacuum purging pump. By rotating and positioning the rotor any pipe may be selected either in sequence or at random whilst all the others are automatically purged.

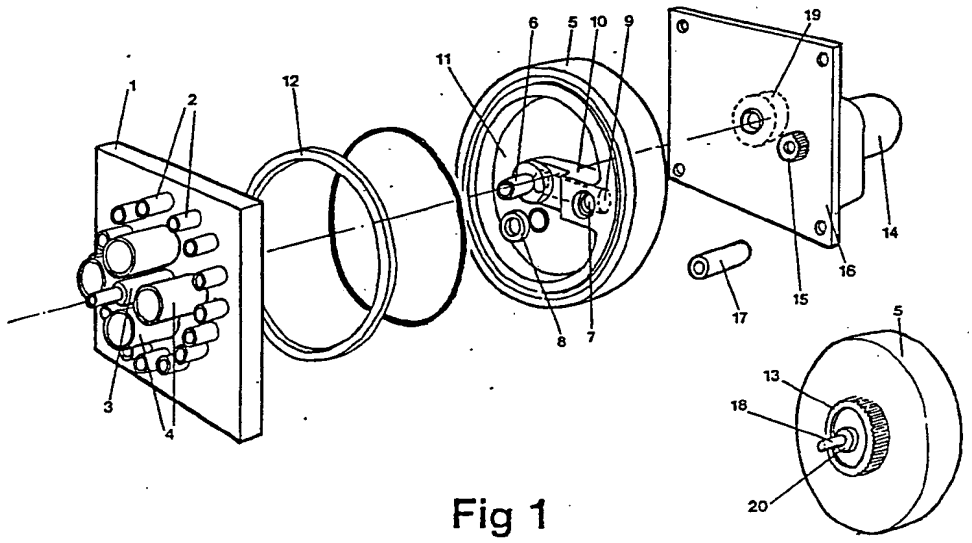

Fig 1

Rear view of rotor

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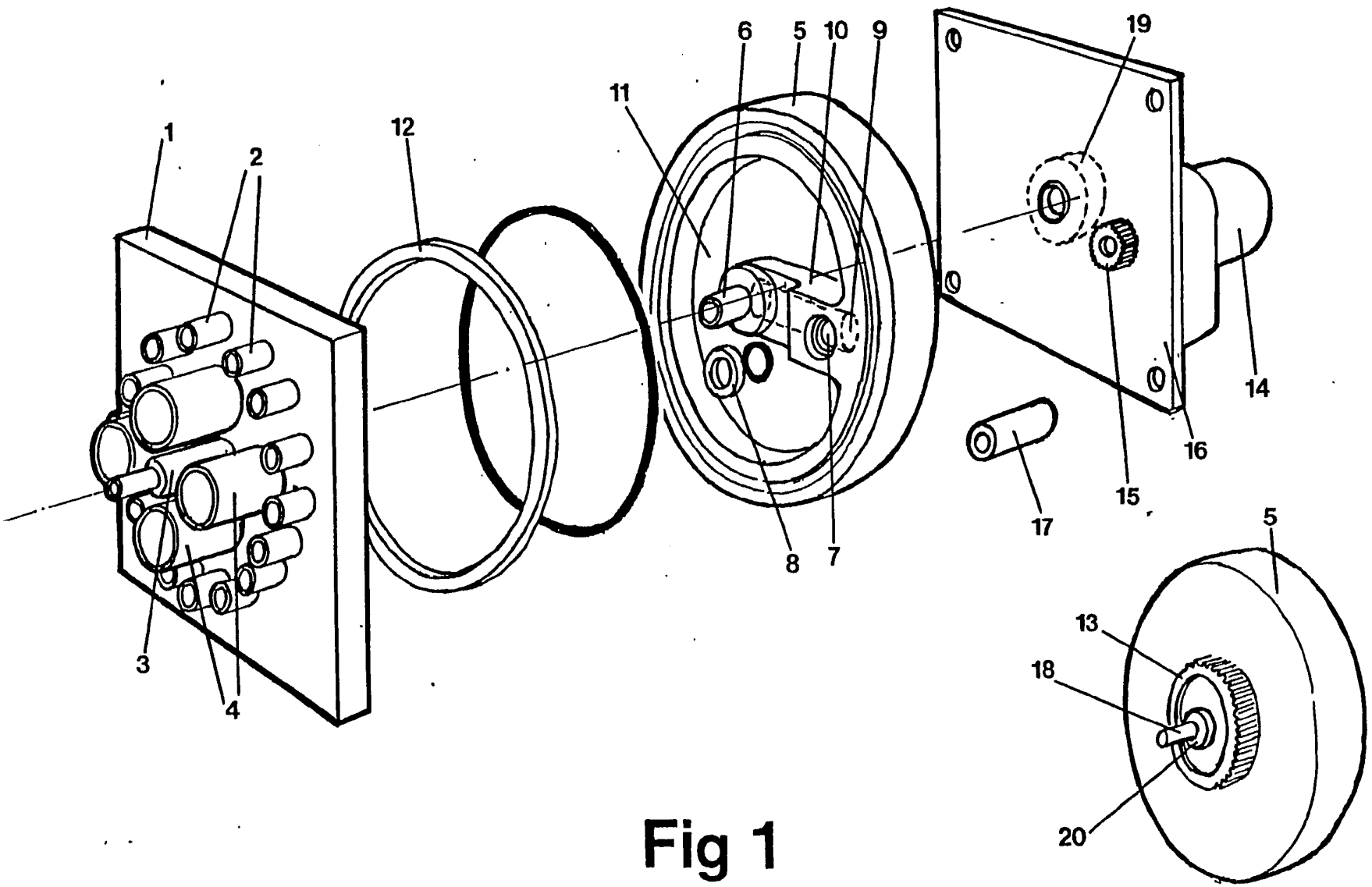

Fig 1

Rear view of rotor

IMPROVEMENTS TO GAS SELECTOR VALVES

In gas analysis systems it is frequently necessary to draw a gas sample from one of an array of pipes each of which conveys gas from a different remote position to the central monitoring point. In order that the gas sample may be fresh the pipes not in use must be continuously purged while the gas sample is being withdrawn and analysed from the selected pipe.

At present this function is accomplished by an array of solenoid-operated changeover valves, one for each tube, all but one of which are switched to a purging vacuum pump whilst the selected pipe is connected to the analyser. This arrangement is very expensive when the number of pipes is large and it is the purpose of this invention to provide a better cost-effective solution to the problem.

The new valve consists of a stator to which the sampling pipes are brought and arranged in a circular ring. The outlets are coupled to a rotor so shaped and positioned that only one pipe is connected through to the analyser whilst all the others are connected to the vacuum purging pump. By rotating and positioning the rotor any pipe may be selected either in sequence or at random whilst all the others are automatically purged.

The following is a description, by way of example, of a preferred method of constructing the valve. Fig.1 shows an exploded view of the valve.

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The stator plate 1 has a circular array of stub tubes 2 pressed into holes equally spaced on a pitch circle with its centre round a bearing sleeve 3. The pipes being sampled are connected to the tubes 2. A circular rotor 5 rotates in conjunction with the stator plate 1 with the tube 6 acting as a bearing in the sleeve 3. Sampling hole 7 surrounded by a PTFE sealing ring 8 is on the same pitch circle as tubes 2 and when positioned over one of the tubes is connected to it pneumatically by the sealing ring 8. Hole 7 is connected pneumatically to tube 6 by a passage 9 drilled into the connecting pillar 10, which is lowered from the contacting surfaces in order to clear the stator exhaust tubes 4. These tubes have approximately the same combined area as the array of inlet tubes 2 minus one tube, and they are connected to the remaining tubes, other than that selected, by means of the rotor cavity 11. A PTFE sealing ring 12 contained in a groove on the periphery of the rotor prevents the ingress of air into the cavity 11 when suction is in progress. It also provides a low-friction face bearing for the rotor and is opposed by another similar ring inserted into the stator. This gives the advantages of low friction and wear and easily replaceable wearing surfaces. The two PTFE sealing rings 8 and 12 are backed by elastomer O-rings to give a perfect seal and spring contact and the grooves are sized so that seal 8 makes contact with the stator face slightly before seal 12 so that any slight irregularity on the surface will give preference to seal 8 which is the more important. Any slight leakage past seal 12 is of no importance as it is being vacuumed to waste. Similarly a leak past seal 8 will not result in contamination of the gas sample but only a slight loss of gas to waste because of the negative pressure in the rotor cavity.

Rotation of the rotor 5 may be effected by means of a gear 13 fixed to its rear surface or by other suitable means. If a gear is used it is convenient

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to drive this by a motor 14 or motor-gearbox unit on the output shaft of which is mounted a pinion 15 engaging gear 13. The motor is mounted on a rear stator plate 16 which is bolted parallel to the front stator 1 with spacers 17, the rotor 5 being sandwiched between them.

A shaft 18 fixed to the rotor and gear 13 protrudes through a hole in the centre of the rear stator plate and carries a shaft encoder or switch 19 which has the same number of binary coded positions as there are tube inlets on the stator and enables the rotor to be positioned accurately over each of the inlet tubes by the motor acting as a positioning servo by well-known means. A compression washer 20 positioned on shaft 18 between the rotor and rear stator keeps the rotor and seal assembly in close face to face contact with the stator 1.

The rotary selector valve may be constructed from materials suited to the application. For normal air sampling, suitable materials for the stator and rotor would be rigid PVC or other easily machined or formed plastic with an aluminium alloy rear stator. The tubes can be stainless steel. For corrosive or elevated temperature atmospheres PTFE is a suitable material for stator and rotor with stainless steel or monel tubes. For very high temperatures, where lubrication and sealing are difficult or solid deposition is possible, stainless steel for the stator and bronze for the rotor in close contact would be an appropriate combination to avoid seizure.

The principal advantages of this concept in comparison with existing methods using arrangements of discrete valves are:-

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(i) simplicity and small size substantially independent of number of inlets.

(ii) a standard unit of, say, 16 inlets may be used for any number of positions up to 16 by blocking the unused inlets and ignoring their selection without significant cost penalty.

(iii) all unselected inlets are continuously purged to that any position may be selected and the analysis performed immediately.

(iv) perfection of sealing of the rotor/stator combination is not of prime importance because small leakages flow into the waste vacuum and no contamination of the analysis sample takes place.

(v) wiring and control simplicity. A conventional 16-way selector requires a minimum of 17 wires and 16 relays or triacs and has no means of reporting a malfunction, e.g. a sticking valve. This new concept requires only 5 wires for full remote control and confirmation of 16 positions.

(vi) unlike arrays of solenoid valves in which cost is proportional to size, it is easy and convenient to use larger bore sampling pipes than the usual 6mm. Increasing the size to 10mm greatly reduces the airflow resistance and enables the use of a centrifugal fan for purging rather than a positive displacement pump with the advantage of lower cost, longer life and lower noise level.

(vii) occasions arise when it is necessary to sample gases at elevated temperatures, e.g. internal combustion engine development when sampling of the exhaust gases from each cylinder requires the

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valve arrangement to withstand temperatures of the order of 250°C. Solenoid valves which can operate reliably at these temperatures are extremely expensive. By selection of suitable materials the valve which is the subject of this invention may be made to operate at even higher temperatures and also to withstand the effects of corrosive atmospheres and entrained solids which would rapidly cause solenoid valves to malfunction. By way of example, the stator may be a block of stainless steel and the rotor made of bronze, both with mating faces ground and lapped to make close contact without seals or lubrication. Any buildup of carbon, etc., at the interface will be sheared off as the rotor rotates to the next position. To eliminate the need for a high temperature motor and feedback device, the rotor may be driven by means of a flexible coupling from a servo box operating at normal temperature which indexes the flexible coupling and hence the rotor appropriately.

CLAIMS

What we claim is:-

1. A selector valve comprising a circular array of tubes arranged in conjunction with a rotating member which connects to a selected tube as required and allows a passage from the tube so selected to convey a fluid to another point.

2. A selector valve as in claim 1 in which the rotating member is so constructed as to connect the tubes which are not selected to another outlet.

3. A selector valve as in claims 1 and 2 in which the sealing system is surrounded by a low fluid pressure so that minor leakage is outwards and, therefore, does not affect the quality of the fluid being transferred from the selected tube.

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